Cloud Megaregionalization: Valley of the Sun

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Introduction

The constitution of planetary computation has, until recently, coincided with the spread of globalization and followed the logic of free trade, cheap labor and the maximization of profit. In the past decade, however, a new logic – that of geopolitical strategy – has started to change the rules and geographies of this process. As advanced semiconductors become increasingly key to national security, two blocs are emerging - North American and East Asia - from what is still a tangle of complex transactions and fragmented production lines. Rather than one of national retrenchment, this is a process of hemisphericalization: the formation of semi-contiguous blocks of influence, allyship, and material flows. These emerging hemispheres are building distinct and entangled computational stacks, creating their own, competing informational clouds.

The expansion of computation has necessitated the allocation of specific geographic areas for the development of its physical layer—regions such as Silicon Valley during the 1960s and 1970s, or the Shenzhen Special Economic Zone at the zenith of Western offshoring policies. As the project of planetary computation enters the orbit of geopolitics, the location and formation of these Megaregions follow a new ordering logic. The assembly of mines, data centers, high-end manufacturing facilities, research labs and logistical hubs emerging in the Valley of Sun, on the border between Sonora and Arizona, is the manifestation of this new logic.

Global Conflict and the Terraforming of Arizona

The construction of TSMC's new advanced semiconductor fab near Phoenix, Arizona marks an attempt by the US to reshore manufacturing deemed critical to national security. From the transformative effects of the aerospace and defense industries during the Cold War to the emergence of the high-tech sectors, external geopolitical forces have continually shaped Arizona's landscape.

In 1917, German U-boats blockaded the supply of industrial strength Egyptian cotton to the US, and the Goodyear Tire & Rubber Co.'s Aeronautics Department found itself

grappling with a shortage. Woodrow Wilson's Aviation Act had appropriated an unprecedented $640M and given out military contracts to manufacturers like Goodyear to quickly produce thousands of airplanes. Needed for wings, dirigibles and especially airplane tires, cotton was key. In the midst of this crisis, Paul Litchfield, a company executive, recognized Arizona's climate as strikingly similar to Egypt's.

Substituting the American Southwest for the Nile Delta, the company swiftly purchased 16,000 acres to the southwest of Phoenix and founded the town of Goodyear.

The plan was to convert the desert to irrigated farmland. To achieve this, Goodyear would have to deal with another shortage of the war: labor. The new rules and increased border controls of the Immigration, the Espionage and the Travel Control Acts interrupted, for the first time in 7 years, the flow of people escaping the Mexican revolution and fuelled an atmosphere of xenophobic paranoia along the border. A series of violent incidents during customs checks ensued, along with reports of German spies in the Mexican ranks. In August 1918, a gunfight erupted between the Mexican and US forces in Nogales, 200 miles south of Goodyear. Following the incident, authorities in Sonora and Arizona rushed to build fences, beginning a century-long project of linear terraforming.

Goodyear, along with other powerful railroad and farming interests, lobbied Congress to amend the immigration act and was issued permits from the Commissioner General for Immigration to employ over 200,000 temporary workers from Mexico. Thus Goodyear pioneered what would later become the 'Bracero Program'.

Using railroad ties as scrapers, the workers cleared the desert of cactus, sagebrush, mesquite and other vegetation. Firestone and Dunlop soon joined Goodyear in the valley. Farmers in Yuma and the Santa Cruz Valley joined the boom. By 1920, there were almost 230,000 acres of cotton in the state.

The cotton boom and the irrigation systems developed by Goodyear transformed the strip between Phoenix and Nogales into the Sun Corridor – a farming powerhouse.

Today, a new set of international tensions is set to change the region. Just like the cotton shortage of the past, a global chip shortage coupled with rising geopolitical tensions is driving the transformation of the region.

Semiconductors and Geopolitical Strategy

In March 2022, following the Russian invasion of Ukraine, the European Organisation for the Exploitation of Meteorological Satellites barred Russia from using its simulation data for weather forecasts and warnings Weapons experts warned that Western real-time weather data could aid Russian biological and chemical attacks on Ukraine.

This is planetary scale computation, weaponized. Foresight gained from data, collected via networks of satellites controlled by the EU and the US, leveraged in geopolitics. Semiconductors are key components of warfare and national security.

AI chips are one of the most advanced types of semiconductors, composed of several miniaturized components that together compose a "system on chip": Memory, central

processing units and graphic processing units, which in AI chips are used for the ability to perform parallel processing. These chips, which will represent around 20% of the market by 2025, are becoming smaller and more efficient for the type of specialized computation that AI involves – training and building models to make quick, precise inferences.

The same chips that are used in commercial devices are used in the defense industry, with modifications that prize precision, reliability and performance in heat and under radiation. Specialized chips for military use are utilized in electromagnetic spectrum operations, signals intelligence, military communications, space capabilities, radars, jammers and in lethal automation. Three Taiwanese companies control 90% of the market for these chips, called Gallium-Arsenide compound semiconductors.

This makes semiconductors a matter of national security - a race to increase the ability to collect large amounts of data and produce accurate predictions. Strategies and tactics - in trade and in warfare - are a factor of the ability to foresee.

New Geographies of the Cloud

With three Taiwanese companies controlling 90% of advanced semiconductor manufacturing worldwide, Taiwan has become an essential node in the supply chain of this key strategic resource. The importance of the island is of great concern for both China – who claims it as part of its own territory, and for the United States who depend on the rare mix of advanced manufacturing capacity and low labor costs Taiwan has to offer.

As a result TSMC is under pressure to diversify its production sites, bringing them closer to the orbit of the US Government. TSMC's first foray into the United States, in 1998, was marked by trials and tribulations. In Camas, Washington, TSMC's first U.S. factory was beleaguered by cost overruns, logistical problems with local utilities, and a failure to transplant their corporate culture, leading to production setbacks, and stunting the facility's planned growth.

The move to Arizona makes dubious economic sense and founder Morris Chang had been candid about the company's decision to establish a presence in the U.S. at the government's behest[1]. Now, for the $42 billion project in Arizona, TSMC is set to receive $15 billion in U.S. government support[2], though the funding comes with strings attached. Some of these conditions were labeled as "unacceptable", particularly the requirement to share profits with the U.S. government if returns exceed projections.[3]

One condition the government will not negotiate on is restricting chip manufacturing expansion in "foreign countries of concern[4]". US Commerce Secretary Gina Raimondo went on to characterize the factory as "fundamentally a national security initiative"[5].

As the geopolitical implications of semiconductors rise dramatically China and the USA are reshaping the supply chains of their most advanced technologies. The vectors of this global reshuffling are policies and initiatives such as the CHIPS and Science Act and Made

in China 2025, a national industrial strategy to pursue advantages in semiconductor manufacturing.

The American CHIPS and Science Act is the culmination of over ten years of DoD directives and Executive Orders. The showcase of the policy is the boom of billion-dollar semiconductor factories unfolding across the United States. Intel, TSMC's neighbor in Chandler, is expanding its facilities in Arizona and Ohio, while Samsung is opening a site in Texas.

It's not just manufacturing that the US is bringing home. While China controls 95% of the Rare Earth Element market and has been showing interest in prospecting in Greenland and, more recently, Afghanistan, in the US as the reopening of the Mountain Pass Rare Earths mine and the DARPA and MP materials collaboration on a refinery in Texas highlight this broader approach.

Despite its autarchic rhetoric, the CHIPS Act entails fortifying international cooperation through 'friend-shoring' initiatives, reinforcing the outlines of an 'American' hemisphere of a planetary digital infrastructure.

This project relies on coordination with other nations: South Korea announced major tax cuts for semiconductor companies in a bill known as the "K-Chips Act." Japan, India, and the European Union have also announced similar measures.

These changes mean that policy is now as important as market forces for the global semiconductor industry, a situation in which the motives behind current and proposed policies override economics to include national security and technological sovereignty.

This reality is also changing the regions in which the physical layer of the cloud is formed. Between 2018 and 2021 Samsung shut down 6 factories in China and expanded production in the Yongin Semiconductor Cluster, outside of Seoul as well as opening an advanced fabrication site in Texas.

The EU's reshoring policies are seeing the development of the Sachsen-Anhalt Digital Hub, with companies like Intel moving to Magdeburg – an area considered attractive also for the lack of natural disasters.

As The US and China work to disentangle from each other and from Taiwan, some Asian Megaregions are becoming more prominent. These include Vietnam's Ho Chi Min City Tech Hub, the Dholera Special Investment Region in India and –perhaps above all – the region straddling the southern tip of Malaysia, Singapore and and Indonesia, which brings together Malaysian labor costs, Singaporean investment and research capacity and Indonesian access to minerals.

The Alchemy of Thresholds

A similar combination of favorable environmental conditions, proximity to cheaper labor markets and pre-existing research infrastructure is driving the development of the Sun Valley into the primary semiconductor hub in North America.

The US-Mexico border joins two economic and regulatory environments. This juncture lends itself to the labor and capital-intensive project of planetary computation — a resource and opportunity for people and organizations on both sides.

The heavily guarded fence gathers around it other, softer, borders – delimiting regions of exception and suspension. TSMC's factory will become part of Foreign Trade Zone 75, one of seven in Arizona, gaining a series of benefits such as duty exemption on the import of raw materials, duty deferral until inventory enters U.S. commerce and Inverted Tariff Benefits, where the duty on a finished product is less than the duty on its individual parts.

The alchemical properties of these extranational parcels is not lost on the Mexican side, where the border magnetized manufacturing to supply components and assemble products, often in tandem with FTZs.

Following the termination of the Bracero foreign worker Program that Arizona cotton farmers had pioneered, the Border Industrialization Program was set up in 1965 by the Mexican Govt. to address mass unemployment in the northern region of mexico. If Mexican workers could not go to the U.S., then U.S. jobs would have to come to Mexico. The program would allow foreign (primarily U.S.) manufacturers to establish assembly plants in Mexico. These plants, or maquiladoras, imported raw materials and machinery duty-free, assembled products, and then exported the finished products back to the country from which the raw materials originated.

The maquiladora sector, like U.S. manufacturing, has faced pressure from international competitors, particularly Chinese manufacturers. But the imposition of increasing tariffs on trade between the United States and China and the logistical disruptions during the pandemic have led to expectations of a shift towards "nearshoring" for companies reliant on Asia.

In January 2019, the institution of the Zona Libre De La Frontera Norte added one more layer to this complex geography. The program designates what Mexican president Lopez Obrador calls a "last curtain to retain workers in our country" – a 15.5-mile-wide strip along the northern border with a lower Value Added Tax, a reduction in Income Tax, a 100% increase in the minimum wage and the equalization of prices of fuel and energy with the United States.

With these mechanisms in place, the Megaregion can create synergies between extraction, manufacturing and labor necessary for the creation of planetary computation.

Can the Region Sustain Chip Manufacturing?

As strategic decisions draw capital and workers to the Valley of the Sun, it must grapple with the reality of a desert landscape and the prospect of planetary ecological collapse in the very near future.

Factories like TSMC's use an exceptionally high amount of electricity and must now make sure that energy is from sustainable sources. While Arizona's largest energy utility company is planning to shut down all coal generation by 2031 and move toward 100% wind and solar energy by 2050, the lack of sufficient clean energy generation in northern Mexico is often one of the concerns mentioned by manufacturing companies seeking to meet internal and national targets. In response, Mexico is preparing a $48 billion clean energy and manufacturing plan for Sonora. The first plant, in Peñasco has the explicit intention of selling clean energy to Arizona's booming microchip manufacturing industry.

TMSC said its projects will require 10,000 construction workers over the next few years, plus another 10,000 high-tech jobs, including 4,500 new jobs directly with the company over the next few years.

Since 1950, the Phoenix metro area population has grown by over 2034%, from about 200,000 to over 4 million residents. Maricopa county, where Phoenix is located, had the highest growth rate in the US in 2022[6], making it the 5th largest city in the US, bucking covid-19 urban flight trends. The Phoenix metro area is expected to grow by 1.5 people in the next decade, and by 2055, the population is expected to reach about 7.6 million residents.

The ability of the region's resources to sustain population growth is reaching its limits. In Sonora, about 500,000 people are already living in drought conditions. [7] While in Phoenix new subdivision construction was halted this year, as assessments of groundwater showed a deficit of 4.6 million acre feet of water in the next 100 years. One acre foot is generally thought of as the amount of water a typical household uses in a year - meaning the region is lacking water for the population growth it is projected to attract in the next decade. Developers can build only if they can prove the new construction will be provided with water from elsewhere. [8]

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Even with clean energy and building restrictions, the region's temperatures are slouching towards inhabitability. According to climate models, by the mid-21 century Maricopa

county will see 81-91 days with over 105 ° F heat; a doubling in the number of days of extreme heat conditions. less than 9 inches of rain are projected, annually. [12]

Today, the Sun Corridor has become the primary location in the US to develop data centers, such as Meta's 2.5 million square feet data center in Mesa. The region's stable power sources and low propensity for natural disasters translates into reliability for this type of infrastructure. Data centers, however, need cooling, and with thousands of square miles of solar fields and concrete covering the ground, the region's temperatures are slouching towards uninhabitability.

Conclusion

As the international demand for semiconductors continues to grow, it collides with the stark realities of climate change and environmental degradation. This convergence of forces is reshaping the American Southwest, where semiconductor manufacturing is expanding in response to geopolitical strategy and the desire for technological superiority.

As techno-nationalism transforms the Valley of the Sun into a Cloud Megaregion, it must confront the complex exchanges between narratives of technological progress, geopolitical competition, and the ecological limits of the Sonoran desert. The project of reshoring semiconductor production in the American Southwest will depend on the economic backing of an increasingly interventionist US government as well as the ability of regional administrations to counteract conditions which are becoming hostile to human life.

Endnotes

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